(12) UK Patent Application (19) GB (11) 2 135 111 A

(21) Application No 8334138
(22) Date of filing 22 Dec 1983
(30) Priority data
(31) 8222004
(32) 29 Dec 1982
(33) France (FR)
(43) Application published
22 Aug 1984
(51) INT CL[3]
H01M 2/02
(52) Domestic classification
H1B 202
(56) Documents cited
None
(58) Field of search
H1B

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(54) Electrochemical generator and method of assembling same

(57) Unit cells in nestable containers (2) are stacked between two end flanges (3). A first resin compatible with the material of the containers (2) is then moulded over the stack so as to hold in position and insulate the output terminations (4) of the cells. A fibrous felt material (9) impregnated with a second resin is then wrapped around the edges of the bonded stack. The second resin is then permitted to gel and the felt is then overwrapped with woven glassfibre matting impregnated with a third resin. The resulting wrapping also comprises parts (11) folded over the end flanges. The resulting electrochemical generator is adapted to withstand high pressures, of approximately ten bars, for example.

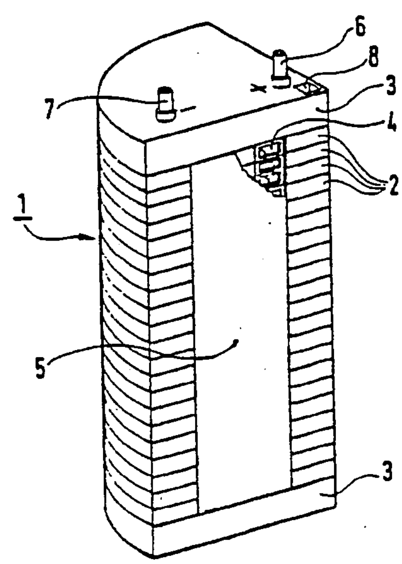

FIG. 1

FIG. 2

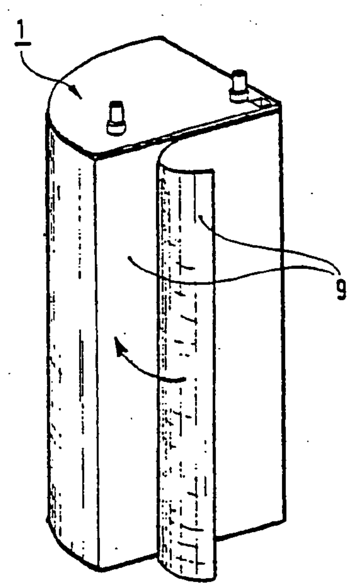

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FIG. 1

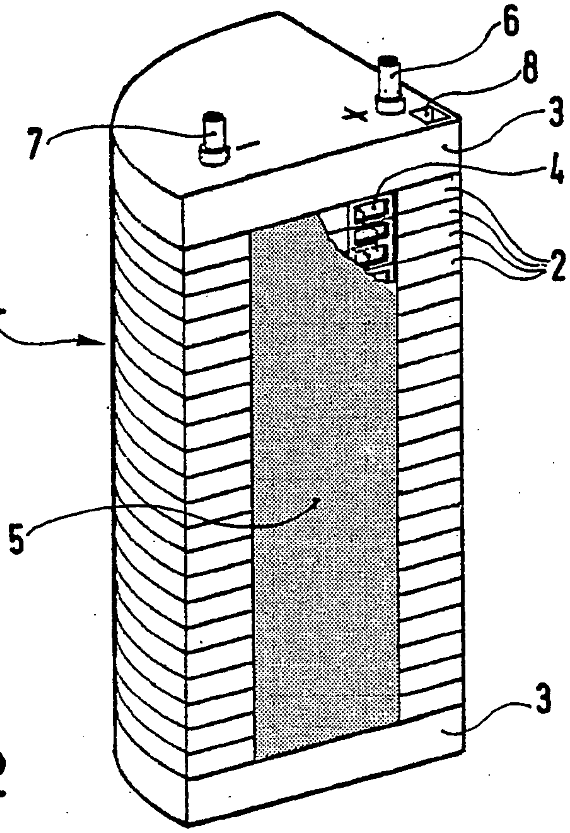


FIG. 2

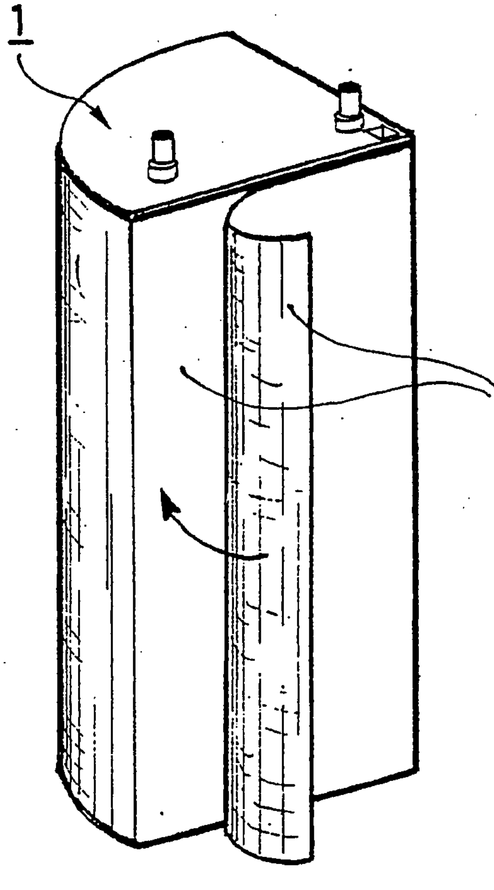


FIG. 3

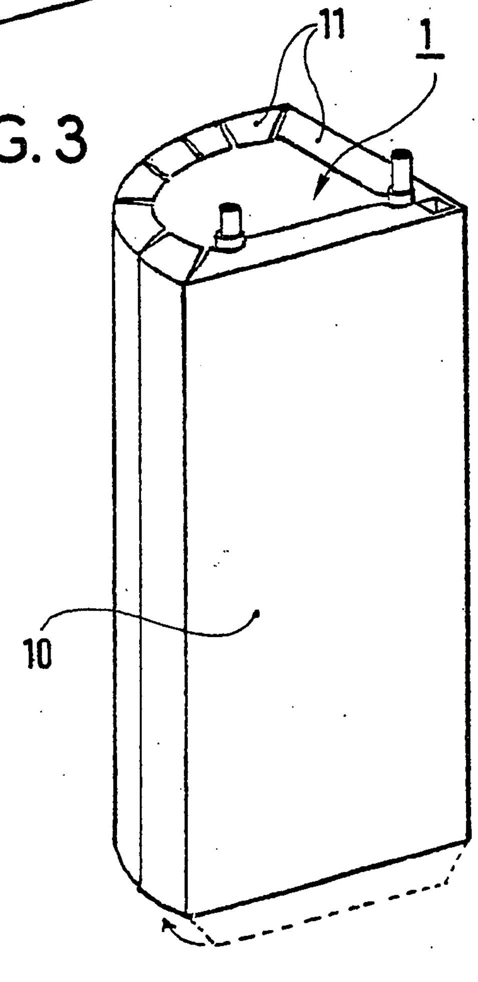


FIG. 4

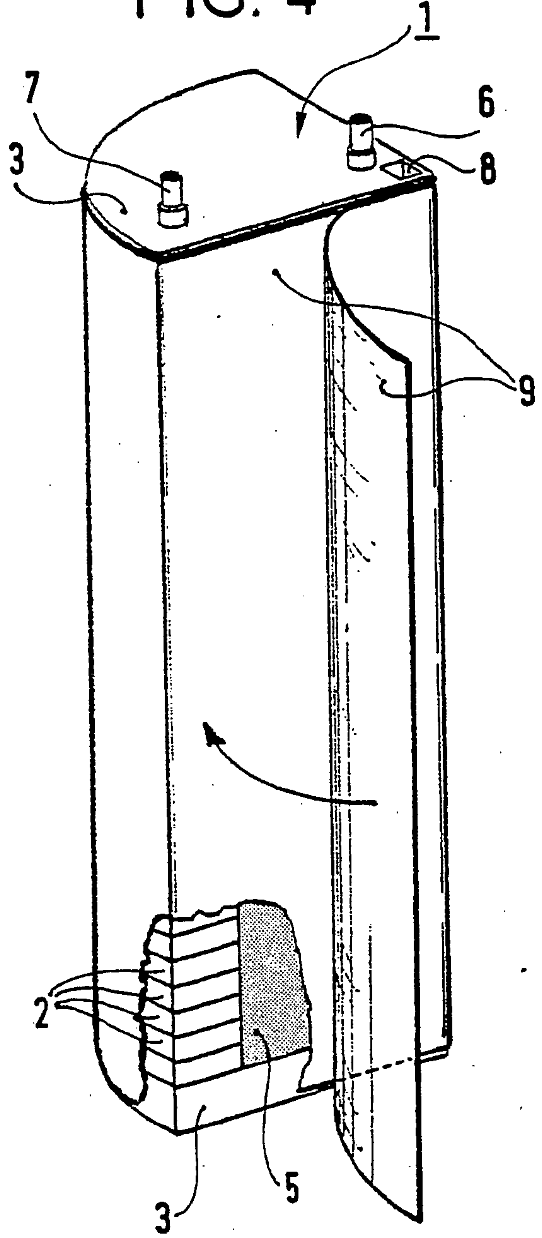


FIG. 5

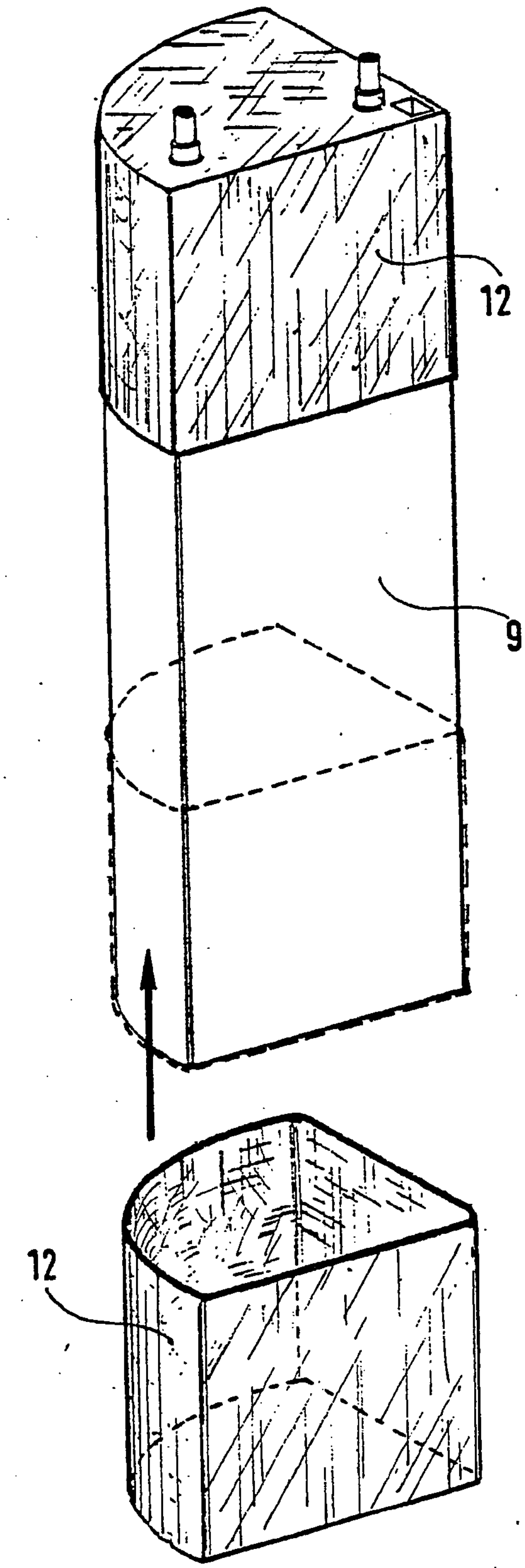
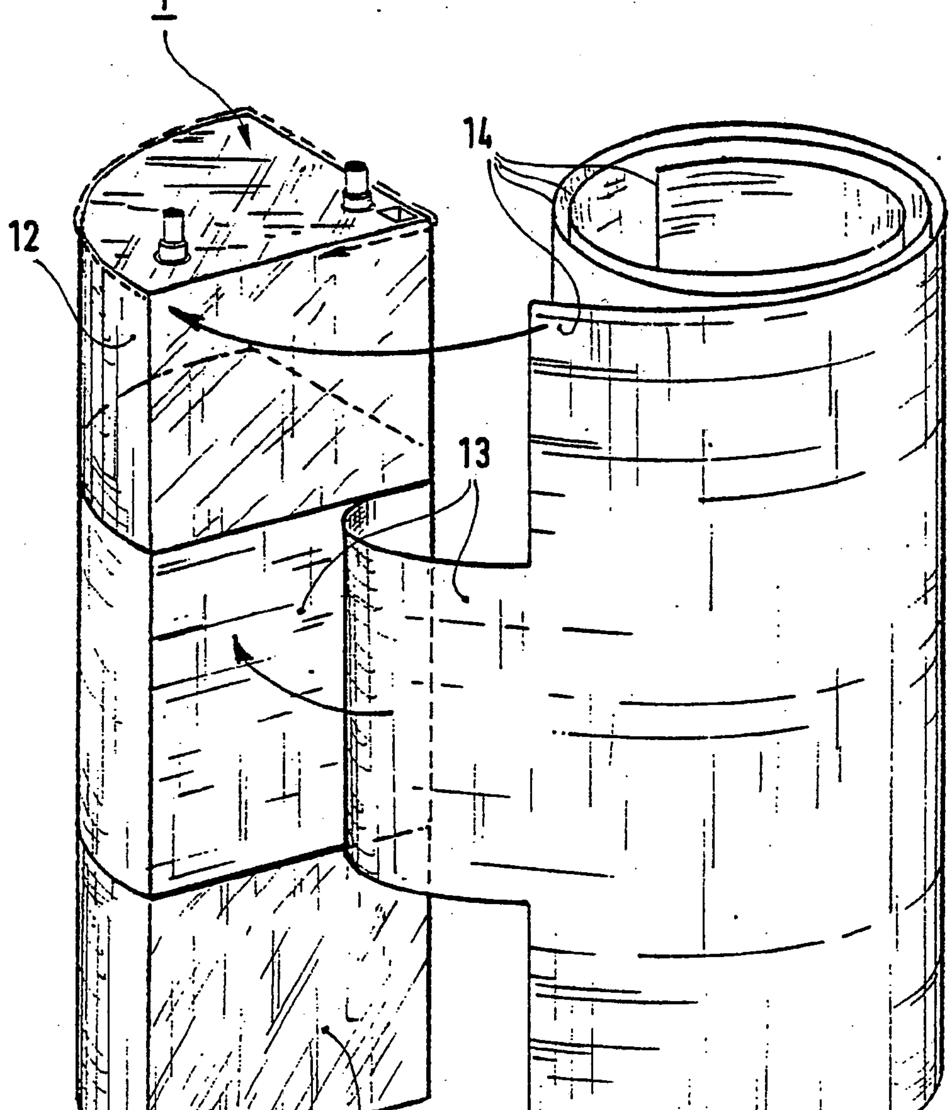


FIG. 6



SPECIFICATION

Electrochemical generator and method of assembling same

The invention concerns a method of assembling an electrochemical generator adapted to withstand high pressures. It is particularly but not exclusively applicable to long shelf life electrochemical generators used in submarine devices and which must retain their sealing properties under a pressure of approximately ten bars.

It is currently known to produce generators of this kind by first stacking unit cells in nestable containers between two end flanges and then moulding a resin compatible with the material of the containers over the stack so as to hold in position and insulate the output terminations of the cells.

So as to hold the assembly together, glass filaments impregnated with resin are then wound on, grooves being possibly provided in the flanges to accommodate the glass filaments, which may extend over the flanges in two perpendicular directions.

Nevertheless, it has been noted that at pressures of the order of eight to ten bars the resulting device may show sealing defects resulting in leakage of electrolyte.

The present invention provides a means whereby these disadvantages may be remedied.

The invention consists in a method of assembling an electrochemical generator adapted to withstand high pressures, in which unit cells in nestable containers are stacked between two end flanges, a first resin compatible with the material of the containers is then moulded over the stack so as to hold in position and insulate the output terminations of the cells, a fibrous felt material impregnated with a second resin is then wrapped around the edges of the bonded stack, the second resin is then permitted to gel, and the felt is then overwrapped with a woven glassfibre matting impregnated with a third resin, the resulting wrapping also comprising parts folded over the end flanges.

The invention also consists in a generator obtained by carrying out this method.

Other characteristics of the invention will emerge from the following description given with reference to the accompanying diagrammatic drawings which show various ways of carrying out the method in accordance with the invention.

Figure 1 is a simplified view in perspective of a generator prior to carrying out the method in accordance with the invention.

Figures 2 and *4* show the application of the felt.

Figure 3 shows a first manner of applying the glassfibre matting.

Figures 5 and *6* show a second way of applying the glassfibre matting.

As can be seen in Figure 1, the electrochemical generator 1 comprises a plurality of unit cells stacked one on another between two end flanges 3. The containers 2 of the cells are in the shape of a quarter-circle and are nestable, in accordance with known arrangements.

Thus the containers are constructed in such a way that the stack has on at least one of its plane lateral surfaces cavities into which emerge the output terminations 4 of the various cells.

Still in accordance with a known method, the output terminations 4 of the cells are held in position and insulated by moulding a resin compatible with the material of which the containers are made over the stack, the resin 5 filling in the aforementioned cavities.

The reference numerals 6 and 7 designate the output terminations of the generator and the reference numeral 8 designates the electrolyte filling orifice.

The flanges 3 may be of a synthetic material, possibly charged with another material. For example, flanges based on polysulphone with a 20 to 30% charge of glass have been used.

The containers 2 are of a plastics material, such as polysulphone, for example, and are made by moulding. To eliminate all traces of release agent, the container walls are mechanically sanded and then degreased, using trichlorotrifluoroethane, for example.

The output terminations of the cells are moulded over with a material which has a coefficient of thermal expansion similar to that of the material from which the containers are made. Thus an epoxy resin may be used. It may be advantageous for this resin to be of a thyxotropic type so as to prevent it entering the containers during the overmoulding operation.

This may be achieved by addition of pyrogenated silica.

Thus the overmoulding may be accomplished with the following mixtures:

Epoxy resin	100 g
Hardener	10 g
Silica	60 – 75 g

So as to seal the containers relative to one another and to the outside, a fibrous felt 9 impregnated with resin is applied to the edge of the stack of juxtaposed containers, as can be seen clearly in Figures 2 and 4, the generator in Figure 4 differing from that in Figure 2 in that it comprises a larger number of unit cells.

A felt comprising multidirectional glass or acrylic fibres may be used for this purpose. This felt is impregnated with a mixture comprising a resin and its hardener.

The mixture impregnating the felt may comprise, in the following proportions:

Epoxy resin (example: XB 3052 A)	100 g
Hardener (example: XB 3052 A)	38 g

The impregnated felt is applied in two thicknesses, so that the overall thickness is approximately 1 mm.

After waiting for gelling to start (approximately four hours with the aforementioned impregnation mixture) the assembly is overwrapped with woven glassfibre matting impregnated with resin, for preference the same resin as that impregnating the felt.

The glassfibre matting is applied over the felt and also folded over onto the end flanges so as to cover these at least in part.

By way of example, a glassfibre matting with a very high modulus of elasticity, preferably with a weight between 500 and 800 g/m^2, may be used for the overwrapping operation.

This matting may have been treated with a light coating of oil so as to facilitate its subsequent bonding with the impregnating resin.

Using a first method, shown in Figure 3, the overwrapping may be carried out by winding impregnated glassfibre matting 10 over the felt in a number of layers (five, for example) and then folding the edges of the matting over the end flanges. The reference numeral 11 designates the parts thus folded over.

After this operation, the assembly is placed in a shaping machine so as to obtain accurately the required dimensions.

In accordance with a second method, applicable in particular to large generators and shown in Figures 5 and 6, the end flanges are covered with precut pieces 12 of glassfibre matting, of sock-like form, which also cover part of the felt 9, leaving an exposed central part. The overlap may extend from each flange over one third of the total height of the felt. Another piece of glassfibre mattng appropriately cut to shape, as shown in Figure 6, is then applied, firstly the part 13 over the area of the felt left uncovered, so as to obtain the same thickness of glassfibre matting wrapping over the entire surface of the felt, the entire surface of the felt then being covered by the part 14.

After this operation, there are placed over the end flanges covered with pieces 12 further precut pieces, in one or two thicknesses which also partly cover the stack, as previously indicated. The assembly is placed in a shaping machine operating perpendicularly to the end flanges so as to achieve the required dimensions and to eliminate air bubbles. A further peripheral wrapping is then applied, initially over the central part so as to obtain the same thickness of covering over the full height of the stack, then terminating with one or more turns over the entire lateral surface of the stack in a manner analogous to that shown in Figure 6.

In this way, the lateral surface of the stack may be covered with a total of five thicknesses of glassfibre matting, the end flanges carrying two or three thicknesses, whereas in accordance with the first method shown in Figure 3, they would carry five thicknesses.

Lateral shaping of the perimeter of the generator is then carried out at ambient temperature.

After this operation, the resin impregnating the glassfibre matting is polymerised, for example by placing the assembly in an oven at a maximum temperature of 50°C.

It has proved possible to obtain in this way generators having excellent mechanical strength combined with a remarkably high degree of sealing. Such generators have shown no signs of failure after being subjected to a pressure of 12 bars for approximately 20 minutes.

It will be well understood that the invention is in no way limited to the embodiments described and represented, which are given by way of example only.

CLAIMS

1. A method of assembling an electrochemical generator adapted to withstand high pressures, in which unit cells in nestable containers are stacked between two end flanges, a first resin compatible with the material of the containers is then moulded over the stack so as to hold in position and insulate the output terminations of the cells, a fibrous felt material impregnated with a second resin is then wrapped around the edges of the bonded stack, the second resin is then permitted to gel, and the felt is then overwrapped with woven glassfibre matting impregnated with a third resin, the resulting wrapping also comprising parts folded over the end flanges.

2. A method according to claim 1, wherein the third resin impregnating the glassfibre matting is the same as the second resin impregnating the felt.

3. A method according to claim 1 or claim 2, wherein, after the resin-impregnated glassfibre matting is applied but before the third resin therein is polymerised, a shaping operation is carried out in order to confer the required dimensions on the generator.

4. A method according to any one of claims 1 to 3, wherein the glassfibre matting overwrap comprises a plurality of layers.

5. A method according to any one of claims 1 to 4, wherein the thickness of the glassfibre matting overwrap is uniform over the entire lateral surfaces of the stack.

6. An electrochemical generator obtained by a method as claimed in any one of claims 1 to 5.

7. A method of assembling an electrochemical generator adapted to withstand high pressures, substantially as herein described with reference to and as illustrated in Figures 1 to 4 of the accompanying diagrammatic drawings.

8. A method of assembling an electrochemical generator adapted to withstand high pressures, substantially as herein described with reference to and as illustrated in Figures 1, 2 and 4 to 6 of the accompanying diagrammatic drawings.

9. An electrochemical generator adapted to withstand high pressures, substantially as herein described with reference to and as illustrated in Figures 1 to 4 of the accompanying diagrammatic drawings.

10. An electrochemical generator adapted to withstand high pressures, substantially as herein described with reference to and as illustrated in Figures 1, 2 and 4 to 6 of the accompanying diagrammatic drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1984.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.